



US008940975B2

(12) **United States Patent**  
**Fowler**

(10) **Patent No.:** **US 8,940,975 B2**  
(45) **Date of Patent:** **Jan. 27, 2015**

(54) **TOMATO VARIETY PICUS**

(75) Inventor: **Charles W. Fowler**, Naples, FL (US)

(73) Assignee: **Seminis Vegetable Seeds, Inc.**,  
Woodland, CA (US)

(\* ) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 394 days.

(21) Appl. No.: **13/372,446**

(22) Filed: **Feb. 13, 2012**

(65) **Prior Publication Data**

US 2012/0210455 A1 Aug. 16, 2012

**Related U.S. Application Data**

(62) Division of application No. 12/849,401, filed on Aug.  
3, 2010, now abandoned, which is a division of  
application No. 12/325,925, filed on Dec. 1, 2008, now  
Pat. No. 7,807,886.

(60) Provisional application No. 60/991,538, filed on Nov.  
30, 2007.

(51) **Int. Cl.**

**A01H 1/00** (2006.01)  
**A01G 1/00** (2006.01)  
**A01H 5/08** (2006.01)  
**C07H 21/04** (2006.01)  
**C07K 14/415** (2006.01)  
**C12N 15/00** (2006.01)

(52) **U.S. Cl.**

CPC ... **A01G 1/00** (2013.01); **A01H 5/08** (2013.01)  
USPC ..... **800/317.4**; 435/468; 435/411; 435/418;  
435/419; 530/350; 530/370; 536/23.1; 536/23.6;  
800/260; 800/278; 800/300; 800/301; 800/302

(58) **Field of Classification Search**

None  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,763,742 A	6/1998	Morrison et al.	800/260
6,414,226 B1	7/2002	Hoogstraten	800/317.4
7,807,886 B2	10/2010	Fowler	800/317.4
7,829,768 B2	11/2010	Frantz	800/317.4
2005/0289674 A1*	12/2005	Ortega Fernandez	800/317.4
2008/0313768 A1	12/2008	Heath	800/268
2009/0119792 A1	5/2009	Frantz	800/260
2009/0144846 A1	6/2009	Fowler	800/317.4
2011/0030083 A1	2/2011	Fowler	800/317.4

OTHER PUBLICATIONS

Larkin et al., *Theor. Appl. Genet.*, vol. 60, 1981, pp. 197-214.\*  
U.S. Application for Plant Variety Protection for Tomato Variety  
(*Lycopersicon esculentum*) FDS 14-2081, filed Nov. 29, 2007.  
U.S. Certificate No. 200800039 for Plant Variety Protection for  
Tomato Variety (*Lycopersicon esculentum*) Picus, dated Dec. 9,  
2008.

\* cited by examiner

*Primary Examiner* — Phuong Bui

(74) *Attorney, Agent, or Firm* — Dentons US LLP; Alissa  
Eagle, Esq.

(57) **ABSTRACT**

The invention provides seed and plants of the tomato variety  
designated Picus. The invention thus relates to the plants,  
seeds and tissue cultures of tomato variety Picus and to meth-  
ods for producing a tomato plant produced by crossing a plant  
of tomato variety Picus with itself or with another tomato  
plant, such as a plant of another variety. The invention further  
relates to seeds and plants produced by such crossing, and  
also relates to parts of a plant of tomato variety Picus includ-  
ing the fruit and gametes of such plants. The invention also  
relates to tomato variety FDS 14-2081, and to seeds and  
plants produced by crossing a plant of tomato variety FDS  
14-2081 with itself or another tomato plant. The present  
invention is also directed to tomato variety FDS 14-2090, and  
to seeds and plants produced by crossing a plant of tomato  
variety FDS 14-2090 with itself or another tomato plant.

**22 Claims, No Drawings**

## TOMATO VARIETY PICUS

This application is a divisional of U.S. application Ser. No. 12/849,401, filed Aug. 3, 2010, now abandoned, which application is a divisional of U.S. application Ser. No. 12/325,925, filed Dec. 1, 2008, now U.S. Pat. No. 7,807,886, which application claims the benefit of priority of U.S. Provisional Application Ser. No. 60/991,538, filed Nov. 30, 2007, each of the entire disclosures of which are incorporated herein by reference in their entireties.

## BACKGROUND OF THE INVENTION

## Field of the Invention

The present invention relates to the field of plant breeding and, more specifically, to the development of tomato varieties Picus, FDS 14-2081 and FDS 14-2090.

The goal of vegetable breeding is to combine various desirable traits in a single variety/hybrid. Such desirable traits may include greater yield, resistance to diseases, insects or other pests, tolerance to heat and drought, better agronomic quality, higher nutritional value, enhanced growth rate and improved fruit properties.

Breeding techniques take advantage of a plant's method of pollination. There are two general methods of pollination: a plant self-pollinates if pollen from one flower is transferred to the same or another flower of the same genotype. A plant cross-pollinates if pollen comes to it from a flower of a different genotype.

Plants that have been self-pollinated and selected for a uniform type over many generations become homozygous at almost all gene loci and produce a uniform population of true breeding progeny of homozygous plants. A cross between two such homozygous plants of different varieties produces a uniform population of hybrid plants that are heterozygous for many gene loci. The extent of heterozygosity in the hybrid is a function of the genetic distance between the parents. Conversely, a cross of two plants each heterozygous at a number of loci produces a segregating population of hybrid plants that differ genetically and are not uniform. The resulting non-uniformity makes performance unpredictable.

## SUMMARY OF THE INVENTION

In one aspect, the present invention provides a tomato plant of the variety designated Picus, or of tomato variety FDS 14-2081 or FDS 14-2090. Also provided are tomato plants having all the physiological and morphological characteristics of such plants. Parts of the tomato plant of the present invention are also provided, for example, including pollen, an ovule, a fruit, a scion, a rootstock and a cell of the plant.

The invention also concerns seed of tomato variety Picus, tomato variety FDS 14-2081 and tomato variety FDS 14-2090. The tomato seed of the invention may be provided as an essentially homogeneous population of tomato seed. Therefore, seed of the invention may be defined as forming at least about 97% of the total seed, including at least about 98%, 99% or more of the seed. The population of tomato seed may be particularly defined as being essentially free from hybrid seed. The seed population may be separately grown to provide an essentially homogeneous population of tomato plants according to the invention.

In another aspect of the invention, a tissue culture of regenerable cells of a plant of variety Picus or tomato variety FDS 14-2081 or FDS 14-2090 is provided. The tissue culture will preferably be capable of regenerating plants capable of

expressing all of the physiological and morphological characteristics of a plant of the invention, and of regenerating plants having substantially the same genotype as other such plants. Examples of some such physiological and morphological characteristics include those traits set forth in the tables herein. The regenerable cells in such tissue cultures may be derived, for example, from embryos, meristems, cotyledons, pollen, leaves, anthers, roots, root tips, pistil, flower, seed and stalks. Still further, the present invention provides tomato plants regenerated from a tissue culture of the invention, the plants having all the physiological and morphological characteristics of a plant of the invention.

In yet another aspect of the invention, processes are provided for producing tomato seeds, plants and fruit, which processes generally comprise crossing a first parent tomato plant with a second parent tomato plant, wherein at least one of the first or second parent tomato plants is a plant of the variety designated Picus, or of tomato variety FDS 14-2081 or FDS 14-2090. These processes may be further exemplified as processes for preparing hybrid tomato seed or plants, wherein a first tomato plant is crossed with a second tomato plant of a different, distinct variety to provide a hybrid that has, as one of its parents, the tomato plant variety FDS 14-2081 or FDS 14-2090. In one embodiment of the invention, tomato varieties FDS 14-2081 and FDS 14-2090 are crossed to produce hybrid seed of the variety designated Picus. In any cross herein, either parent may be the male or female parent. In these processes, crossing will result in the production of seed. The seed production occurs regardless of whether the seed is collected or not.

In one embodiment of the invention, the first step in "crossing" comprises planting seeds of a first and second parent tomato plant, often in proximity so that pollination will occur for example, mediated by insect vectors. Alternatively, pollen can be transferred manually. Where the plant is self-pollinated, pollination may occur without the need for direct human intervention other than plant cultivation.

A second step may comprise cultivating or growing the seeds of first and second parent tomato plants into plants that bear flowers. A third step may comprise preventing self-pollination of the plants, such as by emasculating the male portions of flowers, (e.g., treating or manipulating the flowers to produce an emasculated parent tomato plant). Self-incompatibility systems may also be used in some hybrid crops for the same purpose. Self-incompatible plants still shed viable pollen and can pollinate plants of other varieties but are incapable of pollinating themselves or other plants of the same variety.

A fourth step for a hybrid cross may comprise cross-pollination between the first and second parent tomato plants. In certain embodiments, pollen may be transferred manually or by the use of insect vectors. Yet another step comprises harvesting the seeds from at least one of the parent tomato plants. The harvested seed can be grown to produce a tomato plant or hybrid tomato plant.

The present invention also provides the tomato seeds and plants produced by a process that comprises crossing a first parent tomato plant with a second parent tomato plant, wherein at least one of the first or second parent tomato plants is a plant provided herein, such as from variety Picus, tomato variety FDS 14-2081 and tomato variety FDS 14-2090. In another embodiment of the invention, tomato seed and plants produced by the process are first filial generation ( $F_1$ ) hybrid tomato seed and plants produced by crossing a plant in accordance with the invention with another, distinct plant. The present invention further contemplates plant parts of such an  $F_1$  hybrid tomato plant, and methods of use thereof. There-

fore, certain exemplary embodiments of the invention provide an F<sub>1</sub> hybrid tomato plant and seed thereof.

In still yet another aspect, the present invention provides a method of producing a plant or a seed derived from one or more of variety Picus, tomato variety FDS 14-2081 and tomato variety FDS 14-2090, method comprising the steps of: (a) preparing a progeny plant derived from said variety by crossing a plant of variety Picus, tomato variety FDS 14-2081 or tomato variety FDS 14-2090, with a second plant; and (b) selfing the progeny plant or crossing it to the second plant or to a third plant to produce a seed of a progeny plant of a subsequent generation.

The method may additionally comprise: (c) growing a progeny plant of a subsequent generation from said seed of a progeny plant of a subsequent generation and selfing the progeny plant of a subsequent generation or crossing it to the second, the third, or a further plant; and repeating the steps for an additional 3-10 generations to produce a further plant derived from the aforementioned starting variety. The further plant derived from variety Picus, variety FDS 14-2081 or variety FDS 14-2090 may be an inbred variety, and the aforementioned repeated crossing steps may be defined as comprising sufficient inbreeding to produce the inbred variety. In the method, it may be desirable to select particular plants resulting from step (c) for continued crossing according to steps (b) and (c). By selecting plants having one or more desirable traits, a plant is obtained which possesses some of the desirable traits of the starting plant as well as potentially other selected traits.

The invention also concerns methods of vegetatively propagating a plant of the invention. In certain embodiments, the method comprises the steps of: (a) collecting tissue capable of being propagated from a plant of the invention; (b) cultivating said tissue to obtain proliferated shoots; and (c) rooting said proliferated shoots to obtain rooted plantlets. In some of these embodiments, the method further comprises growing plants from said rooted plantlets.

In another aspect of the invention, a plant of variety Picus, variety FDS 14-2081 or variety FDS 14-2090 comprising an added heritable trait is provided. The heritable trait may comprise a genetic locus that is, for example, a dominant or recessive allele. In one embodiment of the invention, a plant of the invention is defined as comprising a single locus conversion. For example, one or more heritable traits may be introgressed at any particular locus using a different allele that confers the new trait or traits of interest. In specific embodiments of the invention, the single locus conversion confers one or more traits such as, for example, herbicide tolerance, insect resistance, disease resistance and modulation of plant metabolism and metabolite profiles. In further embodiments, the trait may be conferred by a naturally occurring gene introduced into the genome of the variety by backcrossing, a natural or induced mutation, or a transgene introduced through genetic transformation techniques into the plant or a progenitor of any previous generation thereof. When introduced through transformation, a genetic locus may comprise one or more genes integrated at a single chromosomal location.

For example, in certain embodiments, the invention provides methods of introducing a desired trait into a plant of the invention comprising: (a) crossing a plant of variety Picus, variety FDS 14-2081 or variety FDS 14-2090 with a second tomato plant that comprises a desired trait to produce F<sub>1</sub> progeny, (b) selecting an F<sub>1</sub> progeny that comprises the desired trait, (c) crossing the selected F<sub>1</sub> progeny with a plant of variety Picus, variety FDS 14-2081 or variety FDS 14-2090 to produce backcross progeny, and (d) selecting

backcross progeny comprising the desired trait and the physiological and morphological characteristic of variety Picus, variety FDS 14-2081 or variety FDS 14-2090. The invention also provides tomato plants produced by these methods.

In still yet another aspect of the invention, the genetic complement of a tomato plant variety of the invention. The phrase "genetic complement" is used to refer to the aggregate of nucleotide sequences, the expression of which defines the phenotype of, in the present case, a tomato plant of, or a cell or tissue of that plant. A genetic complement thus represents the genetic makeup of a cell, tissue or plant, and a hybrid genetic complement represents the genetic make up of a hybrid cell, tissue or plant. The invention thus provides tomato plant cells that have a genetic complement in accordance with the tomato plant cells disclosed herein, and plants, seeds and plants containing such cells.

Plant genetic complements may be assessed by genetic marker profiles, and by the expression of phenotypic traits that are characteristic of the expression of the genetic complement, e.g., gene expression profiles, gene product expression profiles and isozyme typing profiles. It is understood that a plant of the invention or a first generation progeny thereof could be identified by any of the many well known techniques such as, for example, Simple Sequence Length Polymorphisms (SSLPs) (Williams et al., 1990), Randomly Amplified Polymorphic DNAs (RAPDs), DNA Amplification Fingerprinting (DAF), Sequence Characterized Amplified Regions (SCARs), Arbitrary Primed Polymerase Chain Reaction (AP-PCR), Amplified Fragment Length Polymorphisms (AFLPs) (EP 534 858, specifically incorporated herein by reference in its entirety), and Single Nucleotide Polymorphisms (SNPs) (Wang et al., 1998).

In still yet another aspect, the present invention provides hybrid genetic complements, as represented by tomato plant cells, tissues, plants, and seeds, formed by the combination of a haploid genetic complement of a tomato plant of the invention with a haploid genetic complement of a second tomato plant, preferably, another, distinct tomato plant. In another aspect, the present invention provides a tomato plant regenerated from a tissue culture that comprises a hybrid genetic complement of this invention.

In still yet another aspect, the invention provides a plant of an inbred tomato variety that exhibits a combination of traits comprising a broad adaptability from Florida to Wisconsin, production of an excellent set of uniformly shaped fruit, and resistance to *Alternaria alternata* f. sp. *lycopersici*, *Fusarium oxysporum* f. sp. *lycopersici* race 1, *Stemphylium solani*, *Verticillium albo-atrum* race 1, and Tomato Spotted Wilt Virus. In certain embodiments, the combination of traits may be defined as controlled by genetic means for the expression of the combination of traits found in tomato variety Picus.

In still yet another aspect, the invention provides a method of determining the genotype of a plant of the invention comprising detecting in the genome of the plant at least a first polymorphism. The method may, in certain embodiments, comprise detecting a plurality of polymorphisms in the genome of the plant. The method may further comprise storing the results of the step of detecting the plurality of polymorphisms on a computer readable medium. The invention further provides a computer readable medium produced by such a method.

In certain embodiments, the present invention provides a method of producing tomatoes comprising: (a) obtaining a plant of the invention, wherein the plant has been cultivated to maturity, and (b) collecting tomatoes from the plant.

Any embodiment discussed herein with respect to one aspect of the invention applies to other aspects of the invention as well, unless specifically noted.

The term “about” is used to indicate that a value includes the standard deviation of error for the device or method being employed to determine the value. The use of the term “or” in the claims is used to mean “and/or” unless explicitly indicated to refer to alternatives only or the alternatives are mutually exclusive, although the disclosure supports a definition that refers to only alternatives and to “and/or.” When used in conjunction with the word “comprising” or other open language in the claims, the words “a” and “an” denote “one or more,” unless specifically noted. The terms “comprise,” “have” and “include” are open-ended linking verbs. Any forms or tenses of one or more of these verbs, such as “comprises,” “comprising,” “has,” “having,” “includes” and “including,” are also open-ended. For example, any method that “comprises,” “has” or “includes” one or more steps is not limited to possessing only those one or more steps and also covers other unlisted steps. Similarly, any plant that “comprises,” “has” or “includes” one or more traits is not limited to possessing only those one or more traits and covers other unlisted traits.

Other objects, features and advantages of the present invention will become apparent from the following detailed description. It should be understood, however, that the detailed description and any specific examples provided, while indicating specific embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

#### DETAILED DESCRIPTION OF THE INVENTION

The invention provides methods and compositions relating to plants, plant parts, seeds and derivatives of tomato variety Picus, as well as parent plants capable of being crossed to produce this variety, designated variety FDS 14-2081 and variety FDS 14-2090. Picus is an F1 hybrid Saladette tomato. These plants show genetic uniformity and stability and horticultural uniformity and stability within the limits of environmental influence for the traits described hereinafter. The plants provide sufficient seed yield. By crossing with a distinct second plant, uniform F1 hybrid progeny can be obtained.

Variety Picus exhibits a number of improved traits including its broad adaptability from Florida to Wisconsin and its production of an excellent set of uniformly shaped fruit. In addition, the Picus variety is resistant to *Alternaria alternata* f. sp. *lycopersici*, *Fusarium oxysporum* f. sp. *lycopersici* races 1 and 2, *Stemphylium solani*, *Verticillium albo-atrum* race 1, and Tomato Spotted Wilt Virus. The development of the variety can be summarized as follows. The parents of Picus are particularly useful for the production of hybrid varieties based on the beneficial traits conferred in hybrid combination.

#### A. ORIGIN AND BREEDING HISTORY OF TOMATO VARIETY PICUS

The tomato variety Picus was made by crossing FDS 14-2081 with FDS 14-2090. In one embodiment, Picus is produced by a cross between FDS 14-2081 as the seed parent and FDS 14-2090 as the pollen parent. The breeding objective was to develop an indeterminate elongated cherry tomato inbred variety with good taste, uniform size and good combining ability to be used in the development of hybrid cultivars for the grape tomato category. The variety was deemed stable and uniform after 7 generations of selfing and selection.

The breeding objective of FDS 14-2090 was the development of the variety with a determinate elongated cherry tomato with good taste, uniform size and good combining ability to be used in the development of hybrid cultivars for the grape tomato category. As is true with other tomato varieties, a small percentage of variants can occur within commercially acceptable limits for almost any characteristic during the course of repeated multiplication. However no variants were observed during the two years in which the variety was observed to be uniform and stable.

#### B. PHYSIOLOGICAL AND MORPHOLOGICAL CHARACTERISTICS OF TOMATO VARIETY PICUS

Tomato cultivars may be grouped by maturity, i.e. the time required from planting the seed to the stage where fruit harvest can occur. Standard maturity classifications include ‘early’, ‘midseason’ or ‘late-maturing’. Another classification for tomatoes is the developmental timing of fruit set. ‘Determinant’ plants grow foliage, then transition into a reproductive phase of flower setting, pollination and fruit development. Consequently, determinant cultivars have a large proportion of the fruit ripen within a short time frame. Growers that harvest only once in a season favor determinant type cultivars. In contrast, ‘indeterminate’ types grow foliage, then enter a long phase where flower and fruit development proceed along with new foliar growth. Growers that harvest the same plants multiple times favor indeterminate type cultivars. In response to more recent consumer demands for dietary diversity, tomato breeders have developed a wider range of colors. In addition to expanding the range of red colored fruits, there are cultivars that produce fruits that are creamy white, lime green, yellow, green, golden, orange and purple. Additionally, there are multi-colored varieties exemplified by mainly red fruited varieties with green shoulders, and both striped- and variegated-colored fruit. Standard methods for determining tomato fruit color are described, for instance, in Gull et al. (1989) and Kader et al. (1978), both of which are incorporated by reference herein.

In accordance with one aspect of the present invention, there is provided a plant having the physiological and morphological characteristics of tomato variety Picus. A description of the physiological and morphological characteristics of tomato variety Picus is presented in Table 1.

TABLE 1

Physiological and Morphological Characteristics of Tomato Variety <i>Picus</i>	
CHARACTERISTIC	<i>Picus</i>
Seedling: anthocyanin in hypocotyl of 2-15 cm seedling	Present (Montfavet H 63.4)
Seedling: habit of 3-4 week old seedling	Normal

TABLE 1-continued

CHARACTERISTIC	<i>Picus</i>
Mature plant: height	85 cm
Mature plant: growth type	Determinate (Campbell 1327, Prisca)
Only determinate growth type varieties:	Few
Plant: number of inflorescences on main stem (side shoots to be removed)	(Campbell 1327)
Mature plant: form	Normal
Mature plant: size of canopy (compared to others of similar type)	Medium
Mature plant: habit	Semi-erect
Stem: anthocyanin coloration of upper third	Absent or very weak
Stem: branching	Intermediate (Westover)
Stem: branching at cotyledon or first leafy node	Present
Stem: number of nodes between first inflorescence	7 to 10
Stem: number of nodes between early (1st to 2nd, 2nd to 3rd) inflorescences	1 to 4
Stem: number of nodes between later developing inflorescences	1 to 4
Stem: pubescence on younger stems	Sparsely hairy (scattered long hairs)
Leaf: type	Tomato
(mature leaf beneath the 3rd inflorescence)	
Leaf: morphology	2
(mature leaf beneath the 3rd inflorescence)	
Leaf: margins of major leaflets	Shallowly toothed or scalloped
(mature leaf beneath the 3rd inflorescence)	
Leaf: marginal rolling or wiltiness	Slight
(mature leaf beneath the 3rd inflorescence)	
Leaf: onset of leaflet rolling	Late season
(mature leaf beneath the 3rd inflorescence)	
Leaf: surface of major leaflets	Smooth
(mature leaf beneath the 3rd inflorescence)	
Leaf: pubescence	Normal
(mature leaf beneath the 3rd inflorescence)	
Leaf: attitude	Semi-drooping (Montfave H 63.5)
(in middle third of plant)	
Leaf: length	37.0 cm
Leaf: width	27.0 cm
Leaf: division of blade	Pinnate (Mikado, Pilot, Red Jacket)
Leaf: size of leaflets	Medium
(in middle of leaf)	(Marmande VR, Royesta)
Leaf: intensity of green color	Medium (Lucy)
Leaf: glossiness	Medium
(as for 6)	(Marmande VR)
Leaf: blistering	Medium
(as for 6)	(Marmande VR)
Leaf: size of blisters	
(as for 6)	
Leaf: attitude of petiole of leaflet in relation to main axis	Semi-drooping (Montfave H 63.5)
(as for 6)	
Inflorescence: type	Mainly multiparous
(2nd and 3rd truss)	(Marmande VR)
Inflorescence: type	Forked (2 major axes)
(make observations on the 3rd inflorescence)	
Inflorescence: average number of flowers in inflorescence	6
(make observations on the 3rd inflorescence)	
Inflorescence: leafy or "running" inflorescence	occasional
(make observations on the 3rd inflorescence)	
Flower: calyx	Normal (lobes awl shaped)
Flower: calyx-lobes	Shorter than corolla
Flower: corolla color	Yellow
Flower: style pubescence	spare
Flower: anthers	All fused into tube
Flower: fasciation	Absent
(1st flower of 2nd or 3rd inflorescence)	(Monalbo, Moneymaker)
Flower: color	Yellow (Marmande VR)

TABLE 1-continued

Physiological and Morphological Characteristics of Tomato Variety <i>Picus</i>	
CHARACTERISTIC	<i>Picus</i>
Fruit: typical shape in longitudinal section (3rd fruit of 2nd or 3rd cluster)	7
Fruit: shape of transverse/cross section (3rd fruit of 2nd or 3rd cluster)	1
Fruit: shape of stem end (3rd fruit of 2nd or 3rd cluster)	Indented
Fruit: shape of blossom end (3rd fruit of 2nd or 3rd cluster)	Pointed/tapered (Europeel, Heinz 1706, Hypeel 244, Roma VF)
Fruit: size of blossom scar	Very small (Cerise, Early Mech, Eruopeel, Heinz 1706, Peto Gro, Rio Grande)
Fruit: shape of pistil scar (3rd fruit of 2nd or 3rd cluster)	2
Fruit: peduncle: abscission layer (3rd fruit of 2nd or 3rd cluster)	Present (pedicellate) (Montfavet H 63.5, Roma)
Only for varieties with abscission layers: Peduncle: length (from abscission layer to calyx)	Averaged 1.5 cm
Fruit: ribbing at peduncle end	Weak (Early Mech, Hypeel 244, Melody, Peto Gro, Rio Grande)
Fruit: depression at peduncle end	Medium (Carmello, Count, Fandango, Santi-Pierre)
Fruit: size of stem/peduncle scar	Small (Early Mech, Peto Gro, Rio Grande, Roma)
Fruit: point of detachment of fruit at harvest (3rd fruit of 2nd or 3rd cluster)	At pedicel joint
Fruit: length of dedicel (3rd fruit of 2nd or 3rd cluster)	15 mm
Fruit: length of mature fruit (3rd fruit of 2nd or 3rd cluster)	788 mm
Fill in the length of mature fruit (stem axis)	Check Variety # FLORIDA 7655 753 mm
Fruit: diameter of fruit (3rd fruit of 2nd or 3rd cluster)	513 mm
Fill in the diameter of fruit at widest point	Check Variety # FLORIDA 7655 484 mm
Fruit: weight of mature fruit (3rd fruit of 2nd or 3rd cluster)	108 grams
Fill in the weight of mature fruit	Check Variety # FLORIDA 7655 94.5 grams
Fruit: size	Medium (Alphamech, Diego)
Fruit: ratio length/diameter	Small (Alicia) 1.54
Fruit: core	Present
Fruit: size of core in cross section (in relation to total diameter)	Small (Early Mech, Europeel, Heinz 1706, Peto Gro, Rio Grande, Rossol)
Fruit: number of locules	2 or 3 (Alphamech, Futuria)
Fruit: surface	Smooth
Fruit: base color (mature-green stage)	Light green (Lanai, VF 145-F5)
Fruit: pattern (mature-green stage)	Uniform green
Fruit: green shoulder (before maturity)	Absent (Felicia, Rio Grande, Trust)
Fruit: intensity of green color of fruit (as for 34)	Medium (Rody)
Fruit: color at maturity (full-ripe)	Red (Ferline, Daniela, Montfavet H 63.5)
Fruit: color of flesh at maturity (full-ripe)	Red/crimson (Ferline, Saint-Pierre)
Fruit: flesh color	Uniform
Fruit: locular gel color of table-ripe fruit	Red
Fruit: firmness	Firm (Femova, Konsul, Tradiro)
Fruit: shelf life	Medium (Durinta)

TABLE 1-continued

Physiological and Morphological Characteristics of Tomato Variety <i>Picus</i>	
CHARACTERISTIC	<i>Picus</i>
Time of flowering	Medium (Montfave H 63.5, Prisca)
Time of maturity	Medium (Montfave H 63.5)
Fruit: ripening	Uniform
Fruit: ripening	Uniformity
Fruit: epidermis color	Yellow
Fruit: epidermis	Normal
Fruit: epidermis texture	Average
Fruit: thickness of pericarp	Medium (Carmello, Europeel, Floradade, Heinz 1706, Montfave H 63.5) Check Variety # FLORIDA 7655 Medium
DISEASE AND PEST REACTION: VIRAL DISEASES	
Tomato spotted wilt virus	Highly resistant/present (Lisboa) Resistant few symptoms
FUNGAL DISEASES	
Collar rot or stem canker ( <i>Alternaria solani</i> )	Highly resistant Resistant few symptoms
<i>Fusarium</i> wilt, Race 1 ( <i>F. oxysporum</i> f. <i>lycopersici</i> )	Highly resistant/present (Motelle, Walter) Resistant few symptoms
<i>Fusarium</i> wilt, Race 1 ( <i>F. oxysporum</i> f. <i>lycopersici</i> )	Highly resistant Resistant few symptoms
Gray leaf spot ( <i>Stemphylium</i> spp.)	Highly resistant/present (Motelle) Resistant few symptoms
<i>Verticillium</i> wilt, Race 1 ( <i>V. albo-atrum</i> )	Highly resistant Resistant few symptoms
PHENOLOGY	
Seeding to 50% flow (1 open on 50%)	21 days for Application Variety 25 days for Florida, 7655 (Check variety) 21 days for UC82 (Check variety)
Fruiting season	Long (Marglobe)
Relative maturity in areas tested	Medium late
Adaptation: culture	Field
Adaptation: principle use(s): (if more than one category applies, list all in rank order)	2, 1 1 = home garden 2 = fresh market
Adaptation: regions to which adaptation has been demonstrated (if more than one category applies, list all in rank order)	3, 4, 2, 12 2 = Mid Atlantic 3 = Southeast 4 = Florida 12 = Other (specify): Midwest

\*These are typical values. Values may vary due to environment. Other values that are substantially equivalent are also within the scope of the invention.

Variety *Picus* has been self-pollinated and planted for a number of generations to produce the homozygosity and phenotypic stability to make this variety useful in commercial seed production. No variant traits have been observed or are expected for this variety.

Tomato variety *Picus*, being substantially homozygous, can be reproduced by planting seeds of the variety, growing the resulting tomato plant under self-pollinating or sib-pollinating conditions and harvesting the resulting seeds using techniques familiar to one of skill in the art.

As described above, variety *Picus* exhibits desirable agronomic traits, including its broad adaptability from Florida to Wisconsin, and its production of an excellent set of uniformly shaped fruit. In addition, the *Picus* variety is resistant to *Alternaria alternata* f. sp. *lycopersici*, *Fusarium oxysporum* f. sp. *lycopersici* races 1 and 2, *Stemphylium solani*, *Verticillium albo-atrum* race 1, and Tomato Spotted Wilt Virus. As shown above, variety *Picus* exhibits superior characteristics

when compared to competing varieties. For example, *Picus*, which is a fresh market saladette tomato hybrid similar in fruit shape to the Sunoma, has resistance to Tomato Spotted Wilt Virus whereas Sunoma lacks this resistance.

#### C. DEVELOPMENT OF TOMATO VARIETY FDS 14-2081

The breeding objective for tomato variety FDS 14-2081 was to develop an elongated cherry tomato inbred variety with good taste, uniform size and good combining ability to be used in the development of hybrid cultivars for the grape tomato category. The hybrid *Picus* was developed as a cross of FDS 14-2081 and FDS 14-2090, frequently with FDS 14-2081 used as the female. Tomato variety FDS 14-2081 was produced by crossing TR135-04.5 (BC1F9) with 91FL2619B-13-2-1, F1. Tomato variety TR135-04.5 (BC1F9) was produced by crossing Santa Clara and Stevens (BC1F9).

TABLE 2

Physiological and Morphological Characteristics of Tomato Variety FDS 14-2081	
CHARACTERISTIC	FDS-14-2081
Seedling: anthocyanin in hypocotyl of 2-15 cm seedling	Present (Montfavet H 63.4)
Seedling: habit of 3-4 week old seedling	Normal
Mature plant: height	85 cm
Mature plant: growth type	Determinate (Campbell 1327, Prisca)
Only determinate growth type varieties: Plant: number of inflorescences on main stem (side shoots to be removed)	Few (Campbell 1327)
Mature plant: form	Normal
Mature plant: size of canopy (compared to others of similar type)	Medium
Mature plant: habit	Semi-erect
Stem: anthocyanin coloration of upper third	Absent or very weak
Stem: branching	Intermediate (Westover)
Stem: branching at cotyledon or first leafy node	Present
Stem: number of nodes between first inflorescence	7 to 10
Stem: number of nodes between early (1st to 2nd, 2nd to 3rd) inflorescences	1 to 4
Stem: number of nodes between later developing inflorescences	1 to 4
Stem: pubescence on younger stems	Sparsely hairy (scattered long hairs)
Leaf: type (mature leaf beneath the 3rd inflorescence)	Tomato
Leaf: morphology (mature leaf beneath the 3rd inflorescence)	2
Leaf: margins of major leaflets (mature leaf beneath the 3rd inflorescence)	Shallowly toothed or scalloped
Leaf: marginal rolling or wiltiness (mature leaf beneath the 3rd inflorescence)	Slight
Leaf: onset of leaflet rolling (mature leaf beneath the 3rd inflorescence)	Late season
Leaf: surface of major leaflets (mature leaf beneath the 3rd inflorescence)	Smooth
Leaf: pubescence (mature leaf beneath the 3rd inflorescence)	Normal
Leaf: attitude (in middle third of plant)	Horizontal (Aromata, Triton)
Leaf: length	36.7 cm medium (Lorena)
Leaf: width	30.2 cm medium
Leaf: division of blade	Pinnate (Mikado, Pilot, Red Jacket)
Leaf: size of leaflets (in middle of leaf)	Medium (Marmande VR, Royesta)
Leaf: intensity of green color	Medium (Lucy)
Leaf: glossiness (as for 6)	Medium (Marmande VR)
Leaf: blistering (as for 6)	Medium (Marmande VR)
Leaf: size of blisters (as for 6)	Medium (Marmande VR)
Leaf: attitude of petiole of leaflet in relation to main axis (as for 6)	Semi-erect (Blizzard, Marmande VR)
Inflorescence: type (2nd and 3rd truss)	Mainly multiparous (Marmande VR)
Inflorescence: type (make observations on the 3rd inflorescence)	Simple
Inflorescence: average number of flowers in inflorescence (make observations on the 3rd inflorescence)	5
Inflorescence: leafy or "running" inflorescence (make observations on the 3rd inflorescence)	Absent
Flower: calyx	Normal (lobes awl shaped)
Flower: calyx-lobes	Shorter than corolla
Flower: corolla color	Yellow
Flower: style pubescence	Absent or very scarce (Campbell 1327)
Flower: anthers	All fused into tube
Flower: fasciation (1st flower of 2nd or 3rd inflorescence)	Absent (Monalbo, Moneymaker)

TABLE 2-continued

Physiological and Morphological Characteristics of Tomato Variety FDS 14-2081	
CHARACTERISTIC	FDS-14-2081
Flower: color	Yellow (Marmande VR)
Fruit: typical shape in longitudinal section (3rd fruit of 2nd or 3rd cluster)	7/8
Fruit: shape of transverse/cross section (3rd fruit of 2nd or 3rd cluster)	1
Fruit: shape of stem end (3rd fruit of 2nd or 3rd cluster)	Indented
Fruit: shape of blossom end (3rd fruit of 2nd or 3rd cluster)	flat to pointed/nippled (Cal J, Early Mech, Peto Gro) flat and tapered but not nippled
Fruit: size of blossom scar	Very small (Cerise, Early Mech, Europeel, Heinz 1706, Peto Gro, Rio Grande)
Fruit: shape of pistil scar (3rd fruit of 2nd or 3rd cluster)	1
Fruit: peduncle: abscission layer (3rd fruit of 2nd or 3rd cluster)	Present (pedicellate) (Montfave H 63.5, Roma)
Only for varieties with abscission layers: Peduncle: length (from abscission layer to calyx)	Averaged 1.3 cm
Fruit: ribbing at peduncle end	Weak (Early Mech, Hypeel 244, Melody, Peto Gro, Rio Grande)
Fruit: depression at peduncle end	Weak (Futura, Melody)
Fruit: size of stem/peduncle scar	Small (Early Mech, Peto Gro, Rio Grande, Roma)
Fruit: point of detachment of fruit at harvest (3rd fruit of 2nd or 3rd cluster)	At pedicel joint
Fruit: length of dedicel (3rd fruit of 2nd or 3rd cluster)	13 mm
Fruit: length of mature fruit (3rd fruit of 2nd or 3rd cluster)	608 mm
Fill in the length of mature fruit (stem axis)	Check Variety # FLORIDA 7655 753 mm Check Variety # UC82 569 mm 535 mm
Fruit: diameter of fruit (3rd fruit of 2nd or 3rd cluster)	Check Variety # FLORIDA 7655 484 mm Check Variety # UC82 498 mm 103 grams
Fill in the diameter of fruit at widest point	Check Variety # FLORIDA 7655 94.5 grams Check Variety # UC82 75.2 grams Medium (Alphamech, Diego)
Fruit: weight of mature fruit (3rd fruit of 2nd or 3rd cluster)	1.14
Fill in the weight of mature fruit	Present
Fruit: size (in relation to total diameter)	Small (Early Mech, Europeel, Heinz 1706, Peto Gro, Rio Grande, Rossol)
Fruit: number of locules	2 or 3 (Alphamech, Futuria)
Fruit: surface	Smooth
Fruit: base color (mature-green stage)	Light gray-green
Fruit: pattern (mature-green stage)	Uniform green
Fruit: green shoulder (before maturity)	Absent (Felicja, Rio Grande, Trust)
Fruit: intensity of green color of fruit (as for 34)	Light (Capello, Duranto, Trust)
Fruit: color at maturity (full-ripe)	Red (Ferline, Daniela, Montfave H 63.5)
Fruit: color of flesh at maturity (full-ripe)	Red/crimson (Ferline, Saint-Pierre)
Fruit: flesh color	Uniform
Fruit: locular gel color of table-ripe fruit	Red
Fruit: firmness	Medium (Cristina)

TABLE 2-continued

Physiological and Morphological Characteristics of Tomato Variety FDS 14-2081	
CHARACTERISTIC	FDS-14-2081
Fruit: shelf life	Medium (Durinta)
Time of flowering	Medium (Montfave H 63.5, Prisca)
Time of maturity	Medium (Montfave H 63.5)
Fruit: ripening	Uniform
Fruit: ripening	Uniformity
Fruit: epidermis color	Yellow
Fruit: epidermis	Normal
Fruit: epidermis texture	Average
Fruit: thickness of pericarp	Medium (Carmello, Europeel, Floradade, Heinz 1706, Montfave H 63.5) Check Variety # FLORIDA 7655 Medium Check Variety # UC82 Thick
<b>DISEASE AND PEST REACTION: VIRAL DISEASES</b>	
Tomato spotted wilt virus	Highly resistant/present (Lisboa) Resistant few symptoms
<b>FUNGAL DISEASES</b>	
Collar rot or stem canker ( <i>Alternaria solani</i> )	Highly resistant Resistant few symptoms
<i>Fusarium</i> wilt, Race 1 ( <i>F. oxysporum f. lycopersici</i> )	Highly resistant/present (Motelle, Walter) Resistant few symptoms
Gray leaf spot ( <i>Stemphylium</i> spp.)	Highly resistant/present (Motelle) Resistant few symptoms
<i>Verticillium</i> wilt, Race 1 ( <i>V. albo-atrum</i> )	Highly resistant Resistant few symptoms
<b>CHEMISTRY AND COMPOSITION OF FULL-RIPE FRUITS</b>	
<b>PHENOLOGY</b>	
Seeding to 50% flow (1 open on 50%)	31 days for Application Variety 25 days for Florida 7655 (Check variety) 21 days for UC82 (Check variety)
Fruiting season	Long (Marglobe)
Relative maturity in areas tested	Medium late
Adaptation: culture	Field
Adaptation: principle use(s): (if more than one category applies, list all in rank order)	2, 1 1 = home garden 2 = fresh market
Adaptation: machine harvest	Not adapted
Adaptation: regions to which adaptation has been demonstrated (if more than one category applies, list all in rank order)	2, 3, 4, 12 2 = Mid Atlantic 3 = Southeast 4 = Florida 12 = Other (specify): Midwest

\*These are typical values. Values may vary due to environment. Other values that are substantially equivalent are also within the scope of the invention

D. BREEDING OF TOMATO PLANTS OF THE INVENTION

One aspect of the current invention concerns methods for crossing a tomato variety provided herein with itself or a second plant and the seeds and plants produced by such methods. These methods can be used for propagation of a variety provided herein, or can be used to produce hybrid tomato seeds and the plants grown therefrom. Such hybrid seeds can be produced by crossing the parent varieties of the variety.

The development of new varieties using one or more starting varieties is well known in the art. In accordance with the invention, novel varieties may be created by crossing a plant

of the invention followed by multiple generations of breeding according to such well known methods. New varieties may be created by crossing with any second plant. In selecting such a second plant to cross for the purpose of developing novel varieties, it may be desired to choose those plants that either themselves exhibit one or more selected desirable characteristics or that exhibit the desired characteristic(s) when in hybrid combination. Once initial crosses have been made, inbreeding and selection take place to produce new varieties. For development of a uniform variety, often five or more generations of selfing and selection are involved.

Uniform varieties of new varieties may also be developed by way of double-haploids. This technique allows the creation of true breeding varieties without the need for multiple

generations of selfing and selection. In this manner, true breeding varieties can be produced in as little as one generation. Haploid embryos may be produced from microspores, pollen, anther cultures, or ovary cultures. The haploid embryos may then be doubled autonomously, or by chemical treatments (e.g. colchicine treatment). Alternatively, haploid embryos may be grown into haploid plants and treated to induce chromosome doubling. In either case, fertile homozygous plants are obtained. In accordance with the invention, any of such techniques may be used in connection with a plant of the invention and progeny thereof to achieve a homozygous variety.

Backcrossing can also be used to improve an inbred plant. Backcrossing transfers one or more heritable traits from one inbred or non-inbred source to an inbred that lacks those traits. The exact backcrossing protocol will depend on the characteristic(s) or trait(s) being altered to determine an appropriate testing protocol. When the term variety Picus, variety FDS 14-2081 or variety FDS 14-2090 is used in the context of the present invention, this also includes plants modified to include at least a first desired heritable trait.

This can be accomplished, for example, by first crossing a superior inbred (recurrent parent) to a donor inbred (non-recurrent parent), which carries the appropriate genetic information (e.g., an allele) at the locus or loci relevant to the trait in question. The progeny of this cross are then mated back to the recurrent parent followed by selection in the resultant progeny (first backcross generation, or BC1) for the desired trait to be transferred from the non-recurrent parent. After five or more backcross generations with selection for the desired trait, the progeny are heterozygous at loci controlling the characteristic being transferred, but are like the superior parent for most or almost all other loci. The last backcross generation would be selfed to give pure breeding progeny for the trait being transferred.

The parental tomato plant which contributes the desired characteristic or characteristics is termed the non-recurrent parent because it can be used one time in the backcross protocol and therefore need not recur. The parental tomato plant to which the locus or loci from the non-recurrent parent are transferred is known as the recurrent parent as it is used for several rounds in the backcrossing protocol.

Many single locus traits have been identified that are not regularly selected for in the development of a new inbred but that can be improved by backcrossing techniques. Single locus traits may or may not be transgenic; examples of these traits include, but are not limited to, male sterility, herbicide resistance, resistance to bacterial, fungal, or viral disease, insect resistance, restoration of male fertility, modified fatty acid or carbohydrate metabolism, and enhanced nutritional quality. These comprise genes generally inherited through the nucleus.

Direct selection or screening may be applied where the single locus (e.g. allele) acts in a dominant fashion. For example, when selecting for a dominant allele providing resistance to a bacterial disease, the progeny of the initial cross can be inoculated with bacteria prior to the backcrossing. The inoculation then eliminates those plants which do not have the resistance, and only those plants which have the resistance allele are used in the subsequent backcross. This process is then repeated for all additional backcross generations.

Although backcrossing methods are simplified when the characteristic being transferred is a dominant allele, recessive, co-dominant and quantitative alleles may also be transferred. In this instance, it may be necessary to introduce a test of the progeny to determine if the desired locus has been

successfully transferred. In the case where the non-recurrent variety was not homozygous, the F1 progeny would not be equivalent. F1 plants having the desired genotype at the locus of interest could be phenotypically selected if the corresponding trait was phenotypically detectable in a heterozygous or hemizygous state. In the case where a recessive allele is to be transferred and the corresponding trait is not phenotypically detectable in the heterozygous or hemizygous state, the resultant progeny can be selfed, or crossed back to the donor to create a segregating population for selection purposes. Non-phenotypic tests may also be employed. Selected progeny from the segregating population can then be crossed to the recurrent parent to make the first backcross generation (BC1).

Molecular markers may also be used to aid in the identification of the plants containing both a desired trait and having recovered a high percentage of the recurrent parent's genetic complement. Selection of tomato plants for breeding is not necessarily dependent on the phenotype of a plant and instead can be based on genetic investigations. For example, one can utilize a suitable genetic marker which is closely genetically linked to a trait of interest. One of these markers can be used to identify the presence or absence of a trait in the offspring of a particular cross, and can be used in selection of progeny for continued breeding. This technique is commonly referred to as marker assisted selection. Any other type of genetic marker or other assay that is able to identify the relative presence or absence of a trait of interest in a plant can also be useful for breeding purposes. Procedures for marker assisted selection applicable to the breeding of tomato are well known in the art. Such methods will be of particular utility in the case of recessive traits and variable phenotypes, or where conventional assays may be more expensive, time consuming or otherwise disadvantageous. Types of genetic markers which could be used in accordance with the invention include, but are not necessarily limited to, Simple Sequence Length Polymorphisms (SSLPs) (Williams et al., 1990), Simple Sequence Repeats (SSR), Randomly Amplified Polymorphic DNAs (RAPDs), DNA Amplification Fingerprinting (DAF), Sequence Characterized Amplified Regions (SCARs), Arbitrary Primed Polymerase Chain Reaction (AP-PCR), Amplified Fragment Length Polymorphisms (AFLPs) (EP 534 858, specifically incorporated herein by reference in its entirety), and Single Nucleotide Polymorphisms (SNPs) (Wang et al., 1998).

Tomato varieties can also be developed from more than two parents. The technique, known as modified backcrossing, uses different recurrent parents during the backcrossing. Modified backcrossing may be used to replace the original recurrent parent with a variety having certain more desirable characteristics or multiple parents may be used to obtain different desirable characteristics from each.

Tomatoes are grown for use as rootstocks or scions. Typically, different types of tomatoes are grafted to enhance disease resistance, which is usually conferred by the rootstock, while retaining the horticultural qualities usually conferred by the scion. It is not uncommon for grafting to occur between *Solanum lycopersicum* varieties and related *Solanum* species. Methods of grafting and vegetative propagation are well-known in the art.

The varieties and varieties of the present invention are particularly well suited for the development of new varieties or varieties based on the elite nature of the genetic background of the variety. In selecting a second plant to cross with Picus, variety FDS 14-2081 or variety FDS 14-2090 for the purpose of developing novel tomato varieties, it will typically be preferred to choose those plants that either themselves exhibit one or more selected desirable characteristics or that

exhibit the desired characteristic(s) when in hybrid combination. Examples of desirable characteristics may include, but are not limited to herbicide tolerance, pathogen resistance (e.g., insect resistance, nematode resistance, resistance to bacterial, fungal, and viral disease), male fertility, improved harvest characteristics, enhanced nutritional quality, increased antioxidant content, improved processing characteristics, high yield, improved characteristics related to the fruit flavor, texture, size, shape, durability, shelf life, and yield, improved vine habit, increased soluble solids content, uniform ripening, delayed or early ripening, reduced blossom end scar size, seedling vigor, adaptability for soil conditions, and adaptability for climate conditions. Qualities that may be desirable in a processing tomato are not necessarily those that would be desirable in a fresh market tomato; thus, the selection process for desirable traits for each specific end use may be different. For example, certain features, such as solids content, and firm fruit to facilitate mechanical harvesting are more desirable in the development of processing tomatoes; whereas, external features such as intensity and uniformity of fruit color, unblemished fruit, and uniform fruit size are typically more important to the development of a fresh market product that will have greater retailer or consumer appeal. Of course, certain traits, such as disease and pest resistance, high yield, and concentrated fruit set are of interest in any type of tomato variety or variety.

#### E. PLANTS OF THE INVENTION DERIVED BY GENETIC ENGINEERING

Many useful traits that can be introduced by backcrossing, as well as directly into a plant, are those that are introduced by genetic transformation techniques. Genetic transformation may therefore be used to insert a selected transgene into the tomato variety of the invention or may, alternatively, be used for the preparation of varieties containing transgenes that can be subsequently transferred to the variety of interest by crossing. Methods for the transformation of plants, including tomato, are well known to those of skill in the art. Techniques which may be employed for the genetic transformation of tomato include, but are not limited to, electroporation, microprojectile bombardment, *Agrobacterium*-mediated transformation, pollen-mediated transformation, and direct DNA uptake by protoplasts.

To effect transformation by electroporation, one may employ either friable tissues, such as a suspension culture of cells or embryogenic callus or alternatively one may transform immature embryos or other organized tissue directly. In this technique, one would partially degrade the cell walls of the chosen cells by exposing them to pectin-degrading enzymes (pectolyases) or mechanically wound tissues in a controlled manner.

To effect pollen-mediated transformation, one may apply pollen pretreated with DNA to the female reproduction parts of tomato plants for pollination. A pollen-mediated method for the transformation of tomato is disclosed in U.S. Pat. No. 6,806,399.

A particularly efficient method for delivering transforming DNA segments to plant cells is microprojectile bombardment. In this method, particles are coated with nucleic acids and delivered into cells by a propelling force. Exemplary particles include those comprised of tungsten, platinum, and preferably, gold. For the bombardment, cells in suspension are concentrated on filters or solid culture medium. Alternatively, immature embryos or other target cells may be

arranged on solid culture medium. The cells to be bombarded are positioned at an appropriate distance below the macroprojectile stopping plate.

An illustrative embodiment of a method for delivering DNA into plant cells by acceleration is the Biolistics Particle Delivery System, which can be used to propel particles coated with DNA or cells through a screen, such as a stainless steel or Nytex screen, onto a surface covered with target tomato cells. The screen disperses the particles so that they are not delivered to the recipient cells in large aggregates. It is believed that a screen intervening between the projectile apparatus and the cells to be bombarded reduces the size of projectiles aggregate and may contribute to a higher frequency of transformation by reducing the damage inflicted on the recipient cells by projectiles that are too large.

Microprojectile bombardment techniques are widely applicable, and may be used to transform virtually any plant species.

*Agrobacterium*-mediated transfer is another widely applicable system for introducing gene loci into plant cells. An advantage of the technique is that DNA can be introduced into whole plant tissues, thereby bypassing the need for regeneration of an intact plant from a protoplast. Modern *Agrobacterium* transformation vectors are capable of replication in *E. coli* as well as *Agrobacterium*, allowing for convenient manipulations (Klee et al., 1985). Moreover, recent technological advances in vectors for *Agrobacterium*-mediated gene transfer have improved the arrangement of genes and restriction sites in the vectors to facilitate the construction of vectors capable of expressing various polypeptide coding genes. The vectors described have convenient multi-linker regions flanked by a promoter and a polyadenylation site for direct expression of inserted polypeptide coding genes. Additionally, *Agrobacterium* containing both armed and disarmed Ti genes can be used for transformation.

In those plant species where *Agrobacterium*-mediated transformation is efficient, it is the method of choice because of the facile and defined nature of the gene locus transfer. The use of *Agrobacterium*-mediated plant integrating vectors to introduce DNA into plant cells is well known in the art (Fraleigh et al., 1985; U.S. Pat. No. 5,563,055).

Transformation of plant protoplasts also can be achieved using methods based on calcium phosphate precipitation, polyethylene glycol treatment, electroporation, and combinations of these treatments (see, e.g., Potrykus et al., 1985; Omirulleh et al., 1993; Fromm et al., 1986; Uchimiyama et al., 1986; Marcotte et al., 1988). Transformation of plants and expression of foreign genetic elements is exemplified in Choi et al. (1994), and Ellul et al. (2003).

A number of promoters have utility for plant gene expression for any gene of interest including but not limited to selectable markers, scoreable markers, genes for pest tolerance, disease resistance, nutritional enhancements and any other gene of agronomic interest. Examples of constitutive promoters useful for tomato plant gene expression include, but are not limited to, the cauliflower mosaic virus (CaMV) P-35S promoter, which confers constitutive, high-level expression in most plant tissues (see, e.g., Odel et al., 1985), including monocots (see, e.g., Dekeyser et al., 1990; Terada and Shimamoto, 1990); a tandemly, partially duplicated version of the CaMV 35S promoter, the enhanced 35S promoter (P-e35S) the nopaline synthase promoter (An et al., 1988), the octopine synthase promoter (Fromm et al., 1989); and the figwort mosaic virus (P-FMV) promoter as described in U.S. Pat. No. 5,378,619 and an enhanced version of the FMV promoter (P-eFMV) where the promoter sequence of P-FMV is duplicated in tandem, the cauliflower mosaic virus 19S

promoter, a sugarcane bacilliform virus promoter, a comelina yellow mottle virus promoter, and other plant DNA virus promoters known to express in plant cells.

A variety of plant gene promoters that are regulated in response to environmental, hormonal, chemical, and/or developmental signals can be used for expression of an operably linked gene in plant cells, including promoters regulated by (1) heat (Callis et al., 1988), (2) light (e.g., pea *rbcS-3A* promoter, Kuhlemeier et al., 1989; maize *rbcS* promoter, Schaffner and Sheen, 1991; or chlorophyll *a/b*-binding protein promoter, Simpson et al., 1985), (3) hormones, such as abscisic acid (Marcotte et al., 1989), (4) wounding (e.g., wunl, Siebertz et al., 1989); or (5) chemicals such as methyl jasmonate, salicylic acid, or Safener. It may also be advantageous to employ organ-specific promoters (e.g., Roshal et al., 1987; Scherthaner et al., 1988; Bustos et al., 1989).

Exemplary nucleic acids which may be introduced to the tomato varieties of this invention include, for example, DNA sequences or genes from another species, or even genes or sequences which originate with or are present in the same species, but are incorporated into recipient cells by genetic engineering methods rather than classical reproduction or breeding techniques. However, the term "exogenous" is also intended to refer to genes that are not normally present in the cell being transformed, or perhaps simply not present in the form, structure, etc., as found in the transforming DNA segment or gene, or genes which are normally present and that one desires to express in a manner that differs from the natural expression pattern, e.g., to over-express. Thus, the term "exogenous" gene or DNA is intended to refer to any gene or DNA segment that is introduced into a recipient cell, regardless of whether a similar gene may already be present in such a cell. The type of DNA included in the exogenous DNA can include DNA which is already present in the plant cell, DNA from another plant, DNA from a different organism, or a DNA generated externally, such as a DNA sequence containing an antisense message of a gene, or a DNA sequence encoding a synthetic or modified version of a gene.

Many hundreds if not thousands of different genes are known and could potentially be introduced into a tomato plant according to the invention. Non-limiting examples of particular genes and corresponding phenotypes one may choose to introduce into a tomato plant include one or more genes for insect tolerance, such as a *Bacillus thuringiensis* (B.t.) gene, pest tolerance such as genes for fungal disease control, herbicide tolerance such as genes conferring glyphosate tolerance, and genes for quality improvements such as yield, nutritional enhancements, environmental or stress tolerances, or any desirable changes in plant physiology, growth, development, morphology or plant product(s). For example, structural genes would include any gene that confers insect tolerance including but not limited to a *Bacillus* insect control protein gene as described in WO 99/31248, herein incorporated by reference in its entirety, U.S. Pat. No. 5,689,052, herein incorporated by reference in its entirety, U.S. Pat. Nos. 5,500,365 and 5,880,275, herein incorporated by reference in their entirety. In another embodiment, the structural gene can confer tolerance to the herbicide glyphosate as conferred by genes including, but not limited to *Agrobacterium* strain CP4 glyphosate resistant EPSPS gene (*aroA:CP4*) as described in U.S. Pat. No. 5,633,435, herein incorporated by reference in its entirety, or glyphosate oxidoreductase gene (GOX) as described in U.S. Pat. No. 5,463,175, herein incorporated by reference in its entirety.

Alternatively, the DNA coding sequences can affect these phenotypes by encoding a non-translatable RNA molecule that causes the targeted inhibition of expression of an endog-

enous gene, for example via antisense- or cosuppression-mediated mechanisms (see, for example, Bird et al., 1991). The RNA could also be a catalytic RNA molecule (e.g., a ribozyme) engineered to cleave a desired endogenous mRNA product (see for example, Gibson and Shillito, 1997). Thus, any gene which produces a protein or mRNA which expresses a phenotype or morphology change of interest is useful for the practice of the present invention.

## F. DEFINITIONS

In the description and tables herein, a number of terms are used. In order to provide a clear and consistent understanding of the specification and claims, the following definitions are provided:

Alleles: Alternate forms of a single gene.

Backcrossing: A process in which a breeder repeatedly crosses hybrid progeny, for example a first generation hybrid ( $F_1$ ), back to one of the parents of the hybrid progeny. Backcrossing can be used to transfer genetic information (e.g., an allele) from one genetic background into another.

Crossing: The mating of two parent plants.

Cross-pollination: Fertilization by the union of two gametes from different plants.

Diploid: A cell or organism having two sets of chromosomes.

Emasculate: The removal of plant male sex organs or the inactivation of the organs with a cytoplasmic or nuclear genetic factor conferring male sterility or a chemical agent.

Enzymes: Molecules which can act as catalysts in biological reactions.

$F_1$  Hybrid: The first generation progeny of the cross of two nonisogenic plants.

Genotype: The genetic constitution of a cell or organism.

Haploid: A cell or organism having one set of the two sets of chromosomes in a diploid.

Linkage: A phenomenon wherein alleles on the same chromosome tend to segregate together more often than expected by chance if their transmission was independent.

Locus: A designated location on a chromosome.

Marker: A readily detectable phenotype, preferably inherited in codominant fashion (both alleles at a locus in a diploid heterozygote are readily detectable), with no environmental variance component, i.e., a heritability of 1.

Polyploid: A cell or organism of containing three or more complete sets of chromosomes.

Phenotype: The detectable characteristics of a cell or organism, which characteristics are the manifestation of gene expression.

Quantitative Trait Loci (QTL): Quantitative trait loci (QTL) refer to genetic loci that control to some degree numerically representable traits whose phenotypes are usually continuously distributed.

Regeneration: The development of a plant from tissue culture.

Resistance: As used herein, the terms "resistance" and "tolerance" are used interchangeably to describe plants that show no symptoms to a specified biotic pest, pathogen, abiotic influence or environmental condition. These terms are also used to describe plants showing some symptoms but that are still able to produce marketable product with an acceptable yield. Some plants that are referred to as resistant or tolerant are only so in the sense that they may still produce a crop, even though the plants are stunted and the yield is reduced.

Self-pollination: The transfer of pollen from the anther to the stigma of the same plant.

Single Locus Converted (Conversion) Plant: A plant, often developed through the backcrossing technique, having essentially all of the desired morphological and physiological characteristics of given variety, except that at one locus it contains the genetic material (e.g., an allele) from a different variety. Genetic transformation may also be used to develop single locus converted plants.

Substantially Equivalent: A characteristic that, when compared, does not show a statistically significant difference (e.g.,  $p=0.05$ ) from the mean.

Tetraploid: A cell or organism having four sets of chromosomes.

Tissue Culture: A composition comprising isolated cells of the same or a different type or a collection of such cells organized into parts of a plant.

Transgene: A genetic locus comprising a sequence which has been introduced into the genome of a tomato plant by transformation.

Triploid: A cell or organism having three sets of chromosomes.

#### G. DEPOSIT INFORMATION

A deposit of tomato varieties Picus, FDS 14-2081 and FDS 14-2090, disclosed above and recited in the claims, was made with the American Type Culture Collection (ATCC), 10801 University Blvd., Manassas, Va. 20110-2209. The dates of deposit are Nov. 24, 2014, Nov. 24, 2014, and Nov. 24, 2014, respectively. The accession numbers for those deposited seeds are ATCC Accession No. PTA-121747, ATCC Accession No. PTA-121748, and ATCC Accession No. PTA-121749, respectively. Upon issuance of a patent, all restrictions upon the deposits will be removed, and the deposits are intended to meet all of the requirements of 37 C.F.R. §1.801-1.809. The deposits will be maintained in the depository for a period of 30 years, or 5 years after the last request, or for the effective life of the patent, whichever is longer, and will be replaced if necessary during that period.

Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity and understanding, it will be obvious that certain changes and modifications may be practiced within the scope of the invention, as limited only by the scope of the appended claims.

All references cited herein are hereby expressly incorporated herein by reference.

#### REFERENCES

The following references, to the extent that they provide exemplary procedural or other details supplementary to those set forth herein, are specifically incorporated herein by reference:

U.S. Pat. No. 5,463,175; U.S. Pat. No. 5,500,365; U.S. Pat. No. 5,563,055; U.S. Pat. No. 5,633,435; U.S. Pat. No. 5,689,052; U.S. Pat. No. 5,880,275; U.S. Pat. No. 5,378,619; U.S. Pat. No. 6,806,399.

WO 99/31248

An et al., *Plant Physiol.*, 88:547, 1988.

Bustos et al., *Plant Cell*, 1:839, 1989.

Callis et al., *Plant Physiol.*, 88:965, 1988.

Choi et al., *Plant Cell Rep.*, 13: 344-348, 1994.

Dekeyser et al., *Plant Cell*, 2:591, 1990.

Ellul et al., *Theor. Appl. Genet.*, 107:462-469, 2003.

EP 534 858

Fraley et al., *Bio/Technology*, 3:629-635, 1985.

Fromm et al., *Nature*, 312:791-793, 1986.

Fromm et al., *Plant Cell*, 1:977, 1989.

Gibson and Shillito, *Mol. Biotech.*, 7:125, 1997

Gull et al., *J. Amer. Soc. Hort. Sci.* 114:950-954, 1989.

Kader et al., *Hort. Sci.*, 13:577-578, 1978.

5 Klee et al., *Bio-Technology*, 3(7):637-642, 1985.

Kuhlemeier et al., *Plant Cell*, 1:471, 1989.

Marcotte et al., *Nature*, 335:454, 1988.

Marcotte et al., *Plant Cell*, 1:969, 1989.

Odel et al., *Nature*, 313:810, 1985.

10 Omirulleh et al., *Plant Mol. Biol.*, 21(3):415-428, 1993.

Potrykus et al., *Mol. Gen. Genet.*, 199:183-188, 1985.

Roshal et al., *EMBO J.*, 6:1155, 1987.

Schaffner and Sheen, *Plant Cell*, 3:997, 1991.

Schernthaner et al., *EMBO J.*, 7:1249, 1988.

15 Siebertz et al., *Plant Cell*, 1:961, 1989.

Simpson et al., *EMBO J.*, 4:2723, 1985.

Terada and Shimamoto, *Mol. Gen. Genet.*, 220:389, 1990.

Uchimiya et al., *Mol. Gen. Genet.*, 204:204, 1986.

Wang et al., *Science*, 280:1077-1082, 1998.

20 Williams et al., *Nucleic Acids Res.*, 18:6531-6535, 1990.

What is claimed is:

1. A tomato plant of tomato hybrid variety Picus, a sample of seed of said variety having been deposited under ATCC Accession Number PTA-121747.

25 2. A seed of tomato hybrid variety Picus, a sample of seed of said variety having been deposited under ATCC Accession Number PTA-121747.

3. A plant part of the plant of claim 1.

30 4. The plant part of claim 3, further defined as a leaf, an ovule, pollen, a fruit, or a cell.

5. A tomato plant, or a part thereof, having all the physiological and morphological characteristics of the tomato plant of claim 1.

6. A tissue culture of regenerable cells of the plant of claim 1.

35 7. The tissue culture according to claim 6, comprising cells or protoplasts from a plant part selected from the group consisting of embryos, meristems, cotyledons, pollen, leaves, anthers, roots, root tips, pistil, flower, seed and stalks.

40 8. A tomato plant regenerated from the tissue culture of claim 7, wherein the plant comprises all of the physiological and morphological characteristics of tomato hybrid variety Picus.

9. A method of vegetatively propagating the plant of claim 1 comprising the steps of:

(a) collecting tissue capable of being propagated from the plant according to claim 1;

(b) cultivating said tissue to obtain proliferated shoots; and

(c) rooting said proliferated shoots to obtain rooted plantlets.

10. The method of claim 9, further comprising growing plants from said rooted plantlets.

11. A method of introducing a desired trait into tomato hybrid variety Picus comprising:

45 (a) introducing at least a first heritable trait into at least one tomato variety selected from the group consisting of variety FDS 14-2081 and variety FDS 14-2090 to produce a plant of the first inbred tomato variety that heritably carries the trait, wherein the heritable trait is introduced into said first tomato variety by backcrossing and wherein representative samples of seed of tomato variety FDS 14-2081 and variety FDS 14-2090 have been deposited under ATCC Accession numbers PTA-121748 and PTA-121749, respectively; and

50 (b) crossing a plant of the first inbred tomato variety that heritably carries the trait with a plant of a different line selected from said group consisting of variety FDS

27

14-2081 and variety FDS 14-2090 to produce a plant of hybrid Picus comprising the heritable trait.

12. A method of producing a plant comprising an added desired trait, the method comprising introducing a transgene conferring the desired trait into a plant of tomato variety Picus, a sample of seed of said tomato variety Picus having been deposited under ATCC Accession Number PTA-121747.

13. A method of determining the genotype of the plant of claim 1 comprising obtaining a sample of nucleic acids from said plant and detecting in said nucleic acids a plurality of polymorphisms, thereby determining the genotype.

14. The method of claim 13, further comprising the step of storing the results of detecting the plurality of polymorphisms on a computer readable medium.

15. A method for producing a seed of a variety derived from variety Picus comprising the steps of:

(a) crossing a tomato plant of variety Picus with a second tomato plant, a sample of seed of said variety Picus having been deposited under ATCC Accession Number PTA-121747; and

(b) allowing seed of a variety Picus-derived tomato plant to form.

16. The method of claim 15, further comprising the steps of:

(c) crossing a plant grown from said variety Picus-derived tomato seed with itself or a different tomato plant to yield additional variety Picus-derived tomato seed;

28

(d) growing said additional variety Picus-derived tomato seed of step (c) to yield additional variety Picus-derived tomato plants; and

(e) repeating the crossing and growing steps of (c) and (d) to generate further variety Picus-derived tomato plants.

17. The method of claim 15, wherein the second tomato plant is of an inbred tomato variety.

18. The seed of claim 2, defined as produced by crossing variety FDS 14-2081 with variety FDS 14-2090, a sample of seed of said varieties having been deposited under ATCC Accession Number PTA-121748, and ATCC Accession Number PTA-121749, respectively.

19. The seed of claim 18, wherein one or both of the plant of variety FDS 14-2081 or FDS 14-2090 and the second plant further comprises a transgene.

20. The seed of claim 18, wherein one or both of the plant of variety FDS 14-2081 or FDS 14-2090 and the second plant further comprises a single locus conversion and wherein the conversion was introduced into said lines by transformation or backcrossing.

21. A method of producing a tomato fruit comprising:

(a) obtaining the plant according to claim 1, wherein the plant has been cultivated to maturity; and

(b) collecting tomato from the plant.

22. A method of producing tomato seed comprising crossing variety FDS 14-2081 with variety FDS 14-2090, a sample of seed of said varieties having been deposited under ATCC Accession Number PTA-121748, and ATCC Accession Number PTA-121749, respectively.

\* \* \* \* \*